

ADDITIONAL NOTES ON THE GENUS *GMELINA*. IV

Harold N. Moldenke

*GMELINA* L.

Additional bibliography: Memmler, *Gartenwelt* 16: 606. 1912; Mold., *Phytologia* 56: 32--54. 1984.

*GMELINA* ARBorea Roxb.

Additional bibliography: Mold., *Phytologia* 56: 32 & 35. 1984.

Peh (1964) summarizes pulping studies carried out on trial plantations of this species established in Malaya in 1931, 1932, and 1949, although nursery trees were first grown in Malaya in 1928. He asserts that the wood is a light hardwood with a mean basic specific gravity of 0.403. The "Freshly cut wood is creamy white. The chemical composition of individual woods showed little variation except that the older trees had a higher ash content than that of the younger [ones]. Good yields of unbleached and bleached sulphate pulps were obtained. The strength properties of the unbleached and bleached pulps were found to be better than those of the Australian commercial eucalypt sulphate pulp. The yields of soda pulp were of the same order of magnitude as those of the sulphate. The strength characteristics were inferior to the sulphate pulp, but were improved by bleaching. Cooks of the neutral sulphite semichemical process gave satisfactory yields. The strength properties were comparable to those of the soda pulp if beaten to the same Williams freeness. A high chlorine consumption was needed to bleach the pulp."

*GMELINA* ASIATICA L.

Additional bibliography: Mold., *Phytologia* 56: 32, 35, 42, 43, 47--50, 52, & 53. 1984.

The *Caum* s.n. [Aug. 20, 1934], *Herb. Hort. Bot. Jav. s.n.*, Schubert & Winters 278, and *W. Griffith s.n.* [Malacca, 1845], distributed as *G. asiatica*, are all actually *G. elliptica* J. E. Sm, while *Niyomdham & al.* 241 is *G. philippensis* Cham.

*GMELINA* ELLIPTICA J. E. Sm.

Additional bibliography: Mold., *Phytologia* 56: 43--54. 1984.

Additional citations: GREATER SUNDA ISLANDS: Madura: *Backer 19027* (Bz--21196); *Bremekamp s.n.* (Bz--21194). Paliat: *Backer 29479* (Bz--21186). Sabah: *Amin G. SAN.95465* (Ld); *For. Dept. N. Borneo SAN.15304* (Ld); *Gibot SAN.31278* (Ld); *Madani 35034* (Ld); *Puasa 22* [D. D. Wood 1274] (Ca--239872); *Saikah & Aban SAN.82322* (Sn--49668); *Villamil 315* (Ld--photo, N--photo, Ph, W--1291529). Sepandjang: *Backer 28805* (Bz--21187), *29051* (Bz--21188, Bz--21189, Bz--25574). Simalur: *Achmad 239* in part (Bz--21257, Bz--21258). Sumatra: *Ajoeb 72* (Bz--21249); *Asdat 25* (Bz--72624), *159* (Bz--72623), *191* (Bz--72622); *Bangham & Bangham 627* (N), *628* (N); *Bouman-Houtman 4* (Bz--21244); *Bruinier 122* (Bz--21246); *Docters van Leeuwen-Reijnvaan*

3124 in part (Bz--21247, Bz--21248); Forbes 1576 (N, Vu); Gusdorf 214 (Bz--21250); Krukoff 4422 (Mi, N), 4450 (Br, Bz--21269, Mi, N); Lbrzing 8822 (Bz--21245), 9277 (Bz--21243), 11123 (Bz--21241), 12957a (B); Maradja 442 (A); Posthumus 862 (Bz--21238, Bz--21239, Ut--97474); Toroes 1120 (Mi, Mi), 1440 (Mi, N), 2541 (Ca--531108, Mi, N, W--1868076), 2546 (Mi, Mi, N, W--1861081), 3358 (Mi, N, W--1681222), 3603 (Mi, N, Qu, W--1675869), 3694a [U. S. G. S. pollen 1872] (N, W--1675915), 3962 (Mi, N, W--1680595), 5357 (Mi, N); Van Steenis 9315 (Bz--72808); Yates 817 (Ca--226103), 856 (Ca--225865, Mi); Zom 2 [Boschproefst. bbl23] (Bz--21240). LESSER SUNDA ISLANDS: Banka: Blunnemeijer 1372 (Bz--21253), 1560 (Bz--21254). Salajar: Docters van Leeuwen 1750 (Bz--21237); Teijsmann 13845 (Bz--21236). MOLUCCA ISLANDS: Amboina: Boerlage 243 (Bz--21206); Dollerchal 26 (V), 135 (V); Kornassi 1079 (Bz--21204, Ca--234909, Ut--81000); Rant 339 (Bz--21201); C. B. Robinson 306 (W--654624); Treub 408 (Bz--21205). Ceram: Rutten 1667 (Bz--21207, Ut--80999). CULTIVATED: Belgium: Herb. Martius s.n. [H. B.] (Br). China: Chow 80202 (N). Florida: Gillis 11029 [Pl. Introd. 97933-M.5668] (Ba, Ld); Sheehan R.33 (Ba). Hawaiian Islands: Cawm s.n. [Aug. 20, 1934] (Bi); Yuncker 3587 (Dp). India: Herb. Hort. Bot. Calcutt. s.n. (Mu--739, T). Java: Herb. Hort. Bot. Bogor. 12014 (Bz--21066), H.B.75 (Bz--21259), X.F.14 (Bz--21263, Bz--21264, Bz--21265, Bz--25572), X.F.16 (Bz--21067, Bz--21068, Bz--25573), X.F.17 in part (Bz--21069, Bz--25585), X.F.17a (Bz--21070), XV.F.5 (Bz--21297, Bz--21298, N), XV.F.6 (Bz--26299, Bz--26300, Bz, N), XV.F.7 (Bz--26301), s.n. (Bz--21065, Pd). Mauritius: Bouton s.n. [Pamplemousses, 1835] (Br). Mozambique: Balsinhas & Macuácuva 578 (Ul). Puerto Rico: Schubert & Winters 278 (N). Tahiti: Barrau 2 (Bi). Zaire: Vermoesen s.n. [Eala, 15-12-14] (Br). LOCALITY OF COLLECTION UNDETERMINED: Herb. Linnaeus 780/1 (Ld--photo of type, Ls--type, N--photo of type); Herb. Osbeck s.n. (S); Scortechini 740 (N).

*GMElina* ELLIPTICA f. juv. *LOBATA* (Gaertn.) Mold., Phytologia 4:178.1953.

Synonymy: *Jambosa silvestris parvifolia* Rumpf, Herb. Amboin. 1: 129, pl. 40. 1741. *Gmelina lobata* Gaertn., Fruct. Sem. Pl. 1: 268, pl. 56, fig. 5. 1788. *Jambosa silvestris parvifolia* Rumpf apud J. E. Sm. in Rees, Cyclop., imp. 1 [London], 16: *Gmelina* 1. 1810. *Jambosa silvestris parviflora* Rumpf ex Watt., Dict. Econ. Prod. India 3: 516 in syn. 1889. *Jambosa silvestris* Rumpf ex Mold., Phytol. Mem. 2: 412 in syn. 1980. *Jambosa silvestris parvifolia* Rumpf ex Mold., Phytol. Mem. 2: 412 in syn. 1980.

Bibliography: Rumpf, Herb. Amboin. 1: 129, pl. 40. 1741; Gaertn., Fruct. Sem. Pl. 1: 268, pl. 56, fig. 5. 1788; J. E. Sm. in Rees, Cyclop., imp. 1 [London], 16: *Gmelina* 1 (1810) and imp. 2 [Philad.], 17: *Gmelina* 1. 1820; Schau. in A. DC., Prodr. 11: 679. 1847; Buek, Gen. Spec. Syn. Candoll. 3: 200. 1858; Watt, Dict. Econ. Prod. India 3: 516. 1889; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 1039. 1893; Stapf, Ind. Lond. 3: 299. 1930; Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1074. 1932; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 1039. 1946; Mold., Biol. Abstr. 27: 2026. 1953; Pételot, Pl. Med. Camb. Laos Vietn. 2: 252 (1954) and 4: 119. 1954;

Mold., *Résumé* 184, 187--190, 195, 196, 199, 218, 297, 423, & 456. 1959; *Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 1039.* 1960; *Mold., Résumé Suppl. 12: 8 (1965) and 18: 7.* 1969; *Mold., Fifth Summ. 1: 317, 325, 332, & 363 (1971) and 2: 524, 791, & 880.* 1971; *Mold., Phytologia 34: 269.* 1976; *Mold., Phytol. Mem. 2: 307, 315, 322, 354, 412, 435, & 549.* 1980; *Mold., Phytologia 55: 334 & 494 (1984) and 56: 53.* 1984.

Illustrations: *Rumpf, Herb. Amboin. 1: pl. 40.* 1741; *Gaertn., Fruct. Sem. Pl. 1: pl. 56, fig. 5.* 1788.

This apparently juvenile form, without taxonomic significance, differs in its plainly 2--7-lobed leaves. It sometimes occurs on turions or watersprouts and occasionally even on mature specimens in flower and/or fruit. It appears to be identical to *G. asiatica* f. juv. *lobata* Mold. except that its leaf-blades are conspicuously pubescent beneath, while in the latter they are glabrous.

It should be noted that Gaertner's name, *Gmelina lobata*, may actually have been proposed by him merely as a substitute (and in his view, a more appropriate) name for Linnaeus' *G. asiatica*. Gaertner does not describe the leaves. My description is based on a specimen in the Leiden herbarium so labeled whose leaves are conspicuously pubescent beneath.

Collectors describe *G. elliptica* f. juv. *lobata* as a small thorny shrub, 2--4 m. tall. with yellow corollas (*Occhioni s.n.*). They have encountered it in old clearings at elevations of sealevel to 25 m., in anthesis in March (*Occhioni s.n.*).

Some collections cited below (*viz.*, *Achmat 239, Bakhuizen 1649, Clemens 286, Docters van Leeuwen 3124, Herb. Hort. Bot. Bogor. X.F.17, and LBrzing 12957*) are in part typical *G. elliptica* J. E. Sm. and in part f. juv. *lobata*, but it is not stated on the accompanying labels if the branchlets with unlobed leaves and those with lobed leaves did or did not actually come from the same individual plant, but it is assumed that they did. Anwari Dilmy, in a letter to me dated November 15, 1957, has this to say of the photographed here reproduced; "The photo shows a watersprout cut into 5 sections with lobed leaves and a branch from the upper part of the shoot, cultivated in Hort. Bogor as plant XV F.6 under the name of *G. asiatica* var. *villosa*". He continues: "When making a botanical trip in SE. Java Mr. Jacobs collected on the Blambangan Peninsula material of *Gmelina elliptica* J. E. Sm. The shrub was irregularly branched, and produced peculiar watersprouts, one of which he secured. A comparison with material in the Herbarium Bogoriense, by you identified and labelled, learned that the normal twigs were identical with *G. elliptica*, but that the thorny watersprout with lobed leaves was with *G. elliptica* f. *lobata* (Gaertn.) Moldenke. To make things more certain, he examined living shrubs in the Hortus Bogoriensis, where they are cultivated under the name *G. asiatica* L, var. *villosa* Bakh., garden numbers XV F 6, 7, and 19, he found that the twigs in the upper part of the shrub are thornless and bearing simple leaves, and that the watersprouts, with their branches in the lower part of the shrub are thorned and bearing smaller, lobed leaves."

*Rant 747*, from Amboina, exhibits very tiny, apparently mature,



leaves and very spiny branches and his no. 214 has even smaller leaves borne on *Junellia*-like branches. These collections seem to represent a small-leaved form of *G. elliptica* strongly reminiscent of the so-called *G. parvifolia* Roxb. Schauer (1847), in fact, recognized *G. parvifolia* as a valid and distinct species and reduced *G. lobata* Gaertn to its synonymy. Possibly the form is worthy of formal designation.

Burger 412 represents a very immature seedling of *G. elliptica* f. *juv. lobata* and the vernacular name, "cafe mera", has been reported for it. Material has been identified and distributed in some herbaria as typical *G. elliptica* J. E. Sm., as well as *G. asiatica* L., *G. hystrix* Kurz, *G. parviflora* Pers., *G. philippensis* Cham., *G. villosa* Blume, and even *Vangueria spinosa* Roxb.

Citations: PHILIPPINE ISLANDS: Cebu: M. Ramos, Herb. Philip. Bur. Sci. 11088 (Bz--21219). Mindanao: M. S. Clemens 286 in part (Bz--21215); E. B. Copeland 346 (N, W--850365); Mearns 170 (W--447507); Wilkes s.n. [Caldera] (W--40646). Mindoro: E. D. Merrill 918 (W--435887). Tawi-tawi: S. Olsen 822 (Cp, Ld). Visayas: Lambert & Brunson 26 (W--1863684). GREATER SUNDA ISLANDS: Celebes: Rachmat 699 (Bz--21229). Java: Backer 4582 (Bz--21132), 16579 (Bz--21136), 21385 (Bz--21119), 34145 (Bz--21148); Bakhuizen 1188 (Bz--21096), 1649 in part (Bz--21117, Bz--21118), 3479 (Bz--21084, Bz--21085), 4263 (Bz--21086); Edeling s.n. (Bz--21106); Hallier 271 (Bz--21081),

s.n. [13.XII.1894] (Bz--21098), s.n. [11.VIII.1896] (Bz--21144), s.n. [16.VIII.1896] (Bz--21097), s.n. [24.VIII.1896] (Bz--21145), s.n. (Bz--21099); *Hardenberg* 29 (Bz--21090); *Hoogerwerf* 79 (Bz--21071); *Koorders* 1976\* [32986b] (Bz--21179), 2996\* [23762b] (Bz--21178); *Kostermaans* s.n. (Bz--72916); *Lam* 457j (Bz--21109); *Thorenaar* 264 (Bz--21082, Bz--21083, Cp, Ld--photo, N--photo); *Wolff von Wulfing* 4867 (Bz--21093). Kangean: *Backer* 27331 (Bz--21191), 27548 (Bz--21190). Madura: *Backer* 19799 (Bz--21197, Bz--21198), 20346 (Bz--21195); *Vorderman* 115 (Bz--21199). Saboenting: *Backer* 29904 (Bz--21185). Simalur: *Achmad* 239 in part (Bz--21257). Sumatra: *Docters van Leeuwen* 3124in part (Bz--21248); *Lörzing* 12957b (B). MOLUCCA ISLANDS: Amboina: *Rant* 214 (Bz--21202), 747 (Bz--21203). CULTIVATED: Brazil: *Occhioni* s.n. [Herb. Jard. Bot. Rio Jan. 29542] (B). Germany: *Hiendlmayr* 27 (Mu--1368). Java: *Burger* 412 [2-2-1922] (Bz--21107), 412 [10-6-1922] (Bz--21108); *Herb. Hort. Bot. Bogor.* X.F.17 in part (Bz--21069).

*GMELENA FASCICULIFLORA* Benth. in Benth. & F. Muell., Fl. Austral. 5: 65. 1870.

Synonymy: *Vitex leichhardtii* var. *glabrata* F. Muell. ex Benth. in Benth. & F. Muell., Fl. Austral. 5: 65 in syn. 1870. *Gmelina fasciculifera* F. Muell. ex Uphof, Dict. Econ. Pl., ed. 2, 246. 1968.

Bibliography: Benth. & F. Muell., Fl. Austral. 5: 65. 1870; F. Muell., Sec. Syst. Cens. Austral. Pl. 1: 173. 1889; F. M. Bailey, Cat. Indig. Nat. Pl. Queensl. 35. 1890; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 1039. 1893; Briq. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, 4 (3a): 173. 1895; F. M. Bailey, Queensl. Fl. 4: 1177 & 1178. 1901; F. M. Bailey, Compreh. Cat. Queensl. Pl. 386. 1913; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 69 & 93. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 1039. 1946; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 153 & 186. 1949; Mold., Résumé 209 & 456. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 1039. 1960; Willaman & Schubert, Agr. Res. Serv. U. S. Dept. Agr. Tech. Bull. 1234: 237. 1961; Uphof, Dict. Econ. Pl., ed. 2, 246. 1968; Mold., Résumé Suppl. 18: 12. 1969; Mold., Fifth Summ. 1: 346 (1971) and 2: 523 & 880. 1971; Mold., Phytol. Mem. 2: 337 & 549. 1980; Webb & Tracey in Groves, Austral. Veg. 80, fig. 4.6. 1981; Mold., Phytologia 55: 333. 1984.

Illustrations: Webb & Tracey in Groves, Austral. Veg. fig. 4.6. 1981.

A tall tree, nearly glabrous throughout, except for the inflorescence; leaves decussate-opposite; leaf-blades subcoriaceous, ovate, 7.5--35 cm. long, usually to 24 cm. wide, apically obtuse or obtusely acuminate, shiny above; midrib and secondaries much elevated beneath; tertiaries not nearly as intricately reticulate as in *G. leichhardtii*; inflorescence ferruginous-villous or brown-velvety, the cymes reduced to dense, opposite, sessile clusters along the branches of a terminal panicle, bracteate; bracts at the base of the cyme clusters, broad, shorter than the calyx; pedicels very short or obsolete; calyx usually broadly campanulate, about 4 mm. long, apically truncate or more or less distinctly toothed, externally ferruginous-villous; corolla pale-purple or internally cream-color spotted



with blue, externally villous or brown-velvety, the tube short, much more dilated and oblique than in *G. leichhardtii*, the lower lip fully 1.3 cm. long, with a large, broad middle lobe, the lobes of the upper lip all broad but much shorter than the lowest; fruit not seen.

The species is based on an unnumbered Dallachy collection from Rockingham Bay, Queensland, Australia, but the species is said to occur also in "other tropical scrubs" and in "dense vine forests". Vernacular names recorded for it are "toeah" and "white beech".

Citations: AUSTRALIA: Queensland: *Kajewski* 1337 (N, S); *Michael* 260 (Bz--21268); *Du Rietz* 4262 (S); *C. T. White* 1337 (S).

*GMELENA HAINANENSIS* Oliv. in Hook., Icon. Pl. 19: sub pl. 1874. 1889.

Bibliography: Oliv. In Hook., Icon. Pl. 19: pl. 1874. 1889; Forbes & Hemsl., Journ. Linn. Soc. Lond. Bot. 26 [Ind. Fl. Sin. 2]: 257. 1890; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 185. 1902; Dunn & Tutchter, Kew Bull. Misc. Inf. Addit. Ser. 10: 203. 1912; Chung, Mem. Sci. Soc. China 1 (1): 227. 1924; E. D. Merr., Lingn. Sci. Journ. 5: 158. 1927; P'ei, Mem. Sci. Soc. China 1 (3): [Verbenac. China] 116 & 120--121. 1932; Dop, Rev. Internat. Bot. Appliq. Agric. Trop. 13: 893, 894, & 897. 1933; Dop in Lecomte, Fl. Gén. Indo-chine 4: 842 & 844--845. 1935; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 2, 185. 1941; Mold., Alph. List Inv. Names 24. 1942; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 185. 1959; Mold., Résumé 174 & 456. 1959; Mold., Fifth Summ. 1: 289 & 292 (1971) and 2: 880. 1971; Mold., Phytol. Mem. 2: 279, 281, & 549. 1980; Raj, Rev. Palaeobot. Palyn. 39: 357, 372, & 395. 1983; Mold., Phytologia 55: 336. 337, & 493 (1984) and 56: 34 & 35. 1984.

A tall tree, to 22 m. tall, or erect woody shrub, 2--3 m. tall, with a spreading crown; trunk closely resembling that of *Sapium*, to 90 cm. in girth and 4--18 cm. in diameter at breast height; branchlets pubescent when young, glabrous in age; leaf-scars and lenticels very prominent; flower-buds brownish-gray woolly; leaves decussate-opposite; petioles 3--4.5 cm. long, canaliculate above, brown-pubescent; leaf-blades thick-chartaceous, green above, gray- or bluish-green beneath, broadly ovate, 7--15 cm. long, 5.5--9 cm. wide, apically acute, marginally entire, basally cuneate to truncate, shiny above, downy-pubescent or minutely hispidulous and glandular-hoary beneath; secondaries about 4 per side, prominently elevated beneath; inflorescence terminal, cymose-paniculate, dense; bracts foliaceous, ovate, subsessile, 8--10 mm. long, 5--8 mm. wide, deciduous; flowers ill-scented or odorless, irregular; calyx pale-green, bilabiate, 5-lobed, the lobes broadly ovate-deltoid, externally pubescent and with numerous, large, discoid glands, internally sparsely pubescent; corolla pinkish-white or white to yellow or red, often maroon or purple to lavender and orange within, about 2.5 cm. long, 2 cm. wide at the throat, 2-lipped, both externally and internally glandular-pubescent, the tube about 2.5 cm. long, the lobes fringed with yellowish appressed hairs; stamens 4, white, the filaments and anthers sparsely glandulose; style white, sparsely glandular-pilose; ovary externally densely pubescent; fruit ovoid, about 1.5 cm. long and 1 cm. wide, equaling the fruiting-calyx, glaucescent, green or bluish-green.

This species is based on a B. C. Henry collection from Hainan island, where it appears to be endemic. P'ei (1932) notes that it is distinguishable from all other known Chinese species by its ovoid-deltoid calyx-lobes. He cites from Hainan only *Chun 253 & 1078*, *Hs'ang, Tang. & Fung 97*, *McClure 2724*, and *Tak 500 & 904*.

Raj (1983) describes the pollen on the basis of *How 70453* in the Stockholm herbarium.

The Dop (1933) record from Tonkin, Vietnam, is doubtless a mis-identification of *G. racemosa* (Lour.) Merr.

P'ei (1932) distinguishes the Chinese species known to him as follows:

1. Calyx-rim truncate or shortly toothed, the teeth not over 1.5 mm. long.
2. Ovary densely pubescent, calyx-rim truncate or with only rudimentary teeth; leaf-blades elliptic-ovate.....*G. chinensis*
- 2a. Ovary glabrous or nearly so; calyx-rim short-dentate; leaf-blades broadly elliptic.
  3. Erect trees; leaves large, the blades 10--25 cm. long, 5--18 cm. wide; inflorescence erect.....*G. arborea*
  - 3a. Scandent shrubs, at least when young; leaves small, the blades not over 10 cm. long; inflorescence pendulous....  
*G. asiatica*
- 1a. Calyx-rim distinctly lobed, the lobes to 11 mm. long.
  4. Ovary densely pubescent; calyx with many large glands; leaves large, the blades usually 7--15 cm. long and 5.5--7.5 cm. wide; inflorescence dense.....*G. hainanensis*
  - 4a. Ovary glabrous; calyx usually with only a few large glands; leaves small, not over 2.5 cm. long; inflorescence loose.....  
*G. delavayana*

*Gmelina hainanensis* is sometimes reduced to synonymy under the very similar *G. racemosa* (Lour.) Merr.

Collectors have found *G. hainanensis* growing on cleared hill-sides partly reverting to forest, in woods and mixed or light woods, in thickets, in dense shade, on dry ground, and on open grassy hill-sides, at 320--1700 m. altitude, in flower from March to July, as well as in September, and in fruit in June, August, and September. Fung reports it "fairly common but scattered, in clay on dry gentle slopes", but it is described as "rare" by Lei "on dry level ground in sandy soil of thickets and village commons" and by Lau "in thickets in dry sandy soil on gentle slopes".

The corollas are described as having been "yellow" on *Liang 61767*, "white" on *Lau 75* and *Tsang 704*, "white and yellow" on *Tsang & al. 97*, "white outside, maroon inside" on *McClure 20049* "white or pinkish outside, lavender and orange inside" on *McClure 2724*, "white, but purple inside" on *Ko 52188*, "yellow and purple-red" on *Chun 7007*, "pinkish-white" on *Chun 1078*, "purplish-white" on *Wang 32777*, "white and purple" on *Liang 61985*, "purple with white edge" (Dunn & Tutcher, 1912), "cream" on *Gnessitt 1077*, "red" on *Tsang 500*, "yellowish-white" on *How 71643*, and "white tinged with yellow and purplish-red" on *How 70453*.

Vernacular names recorded for the species are "shek tsz", "shek

tsz shue", "shek tzi shu", and "song tsio gun". McClure asserts that the wood is commercially valuable in boat building.

Dunn & Tutcher (1912) list the species from mainland Kwangtung with a question. The alleged occurrence in Annam is most probably a misinterpretation of *G. racemosa* (Lour.) Merr., a taxon which, along with *G. balansae* Dop, is often erroneously reduced to the synonymy of *G. hainanensis*.

Citations: CHINESE COASTAL ISLANDS: Hainan: *Ching* 5995 (N); *W. Y. Chun* 1078 [Herb. Univ. Nanking 6461] (Ca--239972, N--photo), 7007 (N); *Chun & Tso* 32542 (N), 43542 (Bi, Go, N, S); *Dalziel s.n.* [Wu-king-fu, April 1899] (Ed); *Fung* 20370 (B, Bz--21272, Ca--11447, Mi, N, W--1751157); *Gressitt* 1077 (Gg--316086, I); *How* 70453 (Bi, Go, Mi, N, S), 70801 (Bi, Go, N, S), 71643 (Bz--21271); *Ko* 52188 (B, N, W--1669633); *Lau* 75 (B, Ca--525237, I, Mi, N, W--1629055), 1582 (N), 3664 (Bi, S); *Lei* 450 (B, Ba, Bz--21270, Ca--611281, Mi, N, W--1754103); *Liang* 61767 (B, N, W--1669762), 61985 (Go, N), 63162 (N), 65341 (N); *McClure* 2724 [Herb. Canton Chr. Coll. 9281] (Bi, Gg--127990, N, Ph), 20049 (Ca--603393, N, W--1665058); *Tak* [W.-T. Tsang] 500 [Herb. Lingnan Univ. 17249] (B, Ca--356591, N, W--1659772), 904 [Herb. Lingnan Univ. 16403] (Ca--326121, N, W--1249457); *Tsang, Tang, & Fung* 97 [Herb. Lingnan Univ. 17628] (N, W--1672550); *Wang* 32777 (Go, N, W--1670023).

*GMELENA LEDERMANNI* H. J. Lam, Verbenac. Malay. Arch. 226. 1919.

Bibliography: H. J. Lam, Verbenac. Malay. Arch 216, 226, & 366. 1919; H. J. Lam in Lauterb., Engl. Bot. Jahrb. 59: 94. 1924; A. W. Hill, Ind. Kew. Suppl. 6: 92. 1926; Fedde & Schust., Justs Bot. Jahresber. 60 (2): 573. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 67 & 93 (1942) and ed. 2, 149 & 186. 1949; Mold., Résumé 201 & 456. 1959; Mold., Fifth Summ. 1: 336 (1971) and 2: 880. 1971; Mold., Phytologia 31: 390. 1975; Mold., Phytol. Mem. 2: 327 & 549. 1980; Mold., Phytologia 55: 335 (1984) and 56: 38. 1984.

A usually small tree, 10--30 m. tall; outer bark gray-brown, longitudinally fissured; inner bark yellowish; wood pinkish or white; branchlets minutely pubescent, finally glabrescent; leaves decussate-opposite; petioles 2--4 cm. long, at first minutely pubescent, later glabrescent, red-brown; leaf-blades coriaceous, dull mid-green, broadly ovate or ovate-rotundate, 8--14 cm. long, 4.5--9 cm. wide, apically rotundate or abruptly and obtusely acuminate, marginally entire, basally rotundate or slightly cordate, glabrous above when mature, eglandulose, glabrous beneath except for the subpubescent midrib; secondaries 6--8 per side, with 2 large glands beneath the lowermost; principal veins red-brown; inflorescence paniculate, minutely pubescent, eventually glabrescent, pyramidal, 13--25 cm. long, 2--4 cm. wide. terminal, the corymbs borne in the axils of rotundate bracts which are pubescent on both surfaces; calyx 3 mm. long (after anthesis 5 mm. wide), externally pubescent or glabrous and with a few large glands, the rim irregularly 5-dentate or -sinuate to subtruncate; corolla fulvous-yellow or whitish-pink with a yellow spot on the lower lip, 1.4 cm. long, externally appressed-pubescent, the tube 7 mm. long, the limb oblique, marginally pubescent within, bilabiate, the upper lip small, 2-lobed, the lower



lip larger, 3-lobed, with the middle lobe longer than the other two; stamens 4, slightly exerted; style filiform, the apex subulate, not bifid; ovary externally glabrous except for the rigidly pilose apex, 4-celled, 4-ovulate; fruit drupaceous, consisting of a single pyrene, 4-celled, 4-seeded, blue or violet-purple when mature.

This species is based on *Ledermann 6537* and *10455a* and *Schlechter 8.n.*, the two former from the Malu headquarters, at an altitude of 60 m., near the Sepik river, New Guinea, at least the first number collected in anthesis on March 3, 1912. The Schlechter collection is from near Dschischugari, at 800 m. altitude, New Guinea, collected in bud on May 25, 1909. All three collection are apparently from the northeastern portion of the island, now known as Territory of New Guinea. Lam (1919) comments that "Our species has a close resemblance with *G. Dalrympleana*, but differs from it by its smaller leaves which never have more than 2 basal glands, its narrower inflorescence, its glabrous calyx, and its yellow corolla." It should be noted, however, that in his formal description he distinctly says "calyx pubescens" -- perhaps it is glabrescent in age. Fedde & Schuster (1941) cite only the two Ledermann collections, implying that only these are to be regarded as cotypes.

It should also be noted that in all probability the Schlechter collection, cited without number by Lam, is his *no. 19566*.

The species has been encountered in lowland hill forests, at 12--800 m. altitude, in flower in March and May, and in fruit in May. While Lam emphasized the yellow color of the corolla, Ridsdale implies that it is mostly pinkish-white with only a "yellow mark" on the lower lip.

Citations: NEW GUINEA: Papua: *Ridsdale NGF.31714* (Mu). Territory of New Guinea: F. R. R. *Schlechter 19566* (Br, Ca--226554, F--photo, Ld--photo, N, N--photo, Si--photo).

*GMELENA LEICHHARDTII* (F. Muell.) F. Muell. ex Benth. & F. Muell., *Fl. Austral.* 5: 65. 1870.

Synonymy: *Vitex leichhardtii* F. Muell., *Fragm. Phyt. Austral.* 3: 58. 1862. *Tectona grandis* W. Hill, *Cat. Queensl. Woods* [Lond. Internat. Exhib.] 20. 1862; Domin, *Bibl. Bot.* 89 (6): 1114 in syn. 1928 [not *T. grandis* L. f., 1781]. *Gmelina leichhardtii* F. Muell. ex Jacks. in Hook. f. & Jacks., *Ind. Kew.*, imp. 1, 1: 1039. 1893. *Gmelina leichhardtii* F. Muell. ex Jacks. in Hook. f. & Jacks., *Ind. Kew.*, imp. 1, 2: 1285. 1895. *Gmelina leichhardtii* Benth. ex Briq. in Engl. & Prantl, *Nat. Pflanzenfam.*, ed. 1, 4 (3a): 173. 1895. *Gmelina leichhardtii* Geissman & Hinreiner, *Bot. Rev.* 18: 91. 1952; Mold., *Résumé Suppl.* 16: 22 in syn. 1968. *Gmelina leichhardtii* F. Muell. ex Uphof, *Dict. Econ. Pl.*, ed. 2, 71. 1968. *Gmelina leichhardtii* Lord, *Trees Shrubs Austral. Gard.*, ed. 5, 22. 1978.

Bibliography: W. Hill, *Cat. Queensl. Woods* [Lond. Internat. Exhib.] 20. 1862; F. Muell., *Fragm. Phyt. Austral.* 3: 58 (1862), 3: 168 (1863), and 6: 158. 1868; Benth. & F. Muell., *Fl. Austral.* 5: 65 & 66. 1870; Scheff., *Ann. Jard. Bot. Buitenz.* 1: 42. 1876; F. M. Bailey, *Proc. Linn. Soc. N. S. Wales* 4: 174. 1880; F. Muell., *First Cens.* 103. 1882; F. M. Bailey, *Syn. Queensl. Fl.* 379. 1883; J. Keys,

Proc. Roy. Soc. Queensl. 2: 48. 1885; F. M. Bailey, Queensl. Woods 91. 1888; F. Muell., Sel. Extratrop. Pl., ed. 7, 189. 1888; F. M. Bailey, Queensl. Woods 104. 1889; F. Muell., Second Syst. Cens. Austral. Pl. 1: 171 & 173. 1889; F. M. Bailey, Cat. Indig. Nat. Pl. Queensl. 35. 1890; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 1039 (1893) and imp. 1, 2: 1213 & 1285. 1895; Briq. in Engl. & Prantl. Nat. Pflanzenfam., ed. 1, 4 (3a): 173. 1895; Maiden, Agric. Gaz. N. S. Wales 6: [287]--289 & 681. 1895; F. M. Bailey, Queensl. Fl. 4: 1177 & 1178. 1901; Gamble, Man. Indian Timb., ed. 2, imp. 1, 537 & 778. 1902; Maiden, Commerc. Timb. N. S. Wales, ed. 2, 23. 1904; Maiden, For. Fl. N. S. Wales 1: 185, pl. 33. 1904; MacMahon, Merch. Timb. Queensl. 53. 1905; Maiden, For. Fl. N. S. Wales 2: 199 (1906) and 4 [40], pl. [20] & [21]. 1910; Gerth van Wijk, Dict. Plantnames, imp. 1, 1: 596. 1911; Guilfoyle, Austral. Pl. 187. 1911; F. M. Bailey, Compreh. Cat. Queensl. Pl. 386. 1913; Maiden, Some Princip. Comm. Trees N. S. Wales [N. S. Wales For. Handb.] 207, 1917; H. J. Lam, Verbenac. Malay. Arch. 221. 1919; Gamble, Man. Indian Timb., ed. 2, imp. 2, 537 & 778. 1922; Janssonius, Mikrogr. Holz. Java 804. 1926; Domin, Bibl. Bot. 22 (89): 1114. 1928; Francis, Proc. Linn. Soc. N. S. Wales 53: 474--484, fig. 1--9, & pl. 29--31. 1928; Francis, Austral. Rain-for. Trees, ed. 1, 333--336, fig. 222--224. 1929; Stapf, Ind. Lond. 3: 299. 1930; Dadswell & Eckersley, Austral. Counc. Sci. Ind. Res. Bull. 90: 70, fig. 55. 1935; Wangerin, Justs Bot. Jahresber. 56 (1): 669 (1936) and 58 (1): 845. 1938; Birch & Lyons, Journ. Proc. Roy. Soc. N. S. Wales 71: 391--405. 1938; Fedde, Justs Bot. Jahresber. 58 (2): 550. 1939; Harradence & Lyons, Chem. Abstr. 35: 460. 1941; Mold., Suppl. List Inv. Names 3. 1941; Worsdell, Ind. Lond. Suppl. 1: 441. 1941; Mold., Alph. List Inv. Names 25. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 69 & 93. 1942; Aulin-Erdtman & Erdtman, Chem. Abstr. 38: 5821. 1944; Mold., Phytologia 2: 104. 1945; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 1039 (1946) and imp. 2, 2: 1213 & 1285. 1946; H. N. & A. L. Mold., Pl. Life 2: 69. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 153, 160, & 186. 1949; Metcalfe & Chalk, Anat. Dicot. 2: 1037. 1950; Francis, Austral. Rain-for. Trees, ed. 2, 366--369, fig. 230--231. 1951; Geissman & Hinreiner, Bot. Rev. 18: 91. 1952; Birch, Hughes, & Sm., Austral. Journ. Chem. 7: 83. 1954; Anon., U. S. Dept. Agr. Bot. Subj. Ind. 15: 14357. 1958; Karrer, Konstit. Vork. Org. Pflanzenst. 464. 1958; Mold., Résumé 209, 218, 297, 385, & 456. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 1039 (1960) and imp. 3, 2: 1213 & 1285. 1960; Beadle, Evans, & Carolin, Handb. Vasc. Pl. Sydney Dist. 415. 1962; Gerth van Wijk, Dict. Plantnames, imp. 2, 1: 596. 1962; Streets, Exot. For. Trees Brit. Commonw. 401. 1962; Lord, Shrubs Trees Austral. Gard., ed. 2, 22--23. 1964; Neal, In Gard. Hawaii, ed. 2, 720 & 730. 1965; Burkill, Dict. Econ. Prod. Malay Penins. 1: 1105. 1966; Blomley, Guide Nat. Austral. Pl. 191. 1967; D. & E. Venkata Rao & Viswanadham, Curr. Sci. India 36: 71. 1967; Mold., Résumé Suppl. 16: 22. 1968; Uphof, Dict. Econ. Pl., ed. 2, 71, 246, & 513. 1968; Farnsworth, Blomster, Quimby, & Schermerh., Lynn Ind. 6: 264. 1969; Mold., Résumé Suppl. 18: 12. 1969; Gerth van Wijk, Dict. Plantnames, imp. 3, 1: 596. 1971; Mold., Fifth Summ. 1: 346, 363, &

423 (1971) and 2: 524, 720, & 880. 1971; Beadle, Evans, Carolin, & Tindale, Fl. Sydney Reg., ed. 2, 508. 1972; Gamble, Man. Indian Trees, ed. 2, imp. 3, 537 & 778. 1972; T. B. Muir, Muellera 2: 167. 1972; Hegnauer, Chemotax. Pfl. 6 [Chem. 21]: 663. 1973; Howes, Dict. Useful Pl. 25 & 255. 1974; Napp-Zinn, Anat. Blatt. A (1): 232, 352, & 383. 1974; Mold., Phytologia 34: 269. 1976; Lord, Trees Shrubs Austral. Gard., ed. 5, 22--23. 1978; Mold., Phytol. Mem. 2: 237, 354, & 549. 1980; Francis, Austral. Rain-for. Trees, ed. 4, 366--369 & 372, fig. 230--232. 1981; Mold., Phytologia 50: 261 & 265 (1982) and 54: 240. 1983; Munir in Morley & Toelken, Flow. Pl. Austral. 286 & 287, fig. 174 b & c. 1982; Mold., Phytologia 55: 333 (1984) and 56: 38. 1984.

Illustrations: Maiden, Agric. Gaz. N. S. Wales 6: [287]. 1895; Maiden, For. Fl. N. S. Wales 1: pl. 33 (1904) and 4: pl. [20] & [21]. 1910; Guilfoyle, Austral. Pl. 187. 1911; Maiden, Some Princip. Comm. Trees N. S. Wales [N. S. Wales For. Handb.] 207. 1917; Francis, Proc. Linn. Soc. N. S. Wales 53: pl. 29--31 & fig. 1--9. 1928; Francis, Austral. Rain-for. Trees, ed. 1, 333--335, fig. 222--224. 1929; Dadswell & Eckersley, Austral. Counc. Sci. Ind. Res. Bull. 90: fig. 35. 1935; Francis, Austral. Rain-for. Trees, ed. 2, 366, 368, & 369, fig. 230--232 (1951) and ed. 4, 366, 368, & 369, fig. 230--232. 1981; Munir in Morley & Toelken, Flow. Pl. Austral. 286, fig. 174 b & c. 1983.

A large, usually tall tree, to 130 feet in height; trunk to 4 feet in diameter at breast height, flanged at the base but not prominently buttressed; bark gray or dark-gray, scaly, the scales generally angular but occasionally rounded, brownish-yellow when cut, flesh-color near the sapwood, about 1.25 cm. thick on trees with a 2-foot trunk-diameter; wood white, with a tinge of brown or very pale-brown to gray-brown, medium-textured, strong, very durable, resistant to termite attack, easily worked, subject to little or no shrinkage in dry weather or expansion in wet weather, not likely to warp, plain or rather close-grained, weighing 35--50 pounds per cubic foot; young branches thick, downy-tomentose with light-brownish hairs; leaves decussate-opposite, partly deciduous, quickly detaching in drying; petioles fairly thick, 2.5--3.5 cm. long, downy-pilose with 1--5-celled brownish hairs; leaf-blades subcoriaceous, ovate or broadly ovate, 7--14 cm. long, 1½--3 times as long as wide, apically obtuse or acute to subacuminate, marginally entire, basally obtuse or rounded to cuneate, glabrous and subrugose above, densely and softly downy-tomentose (especially on the venation) beneath with long, weak, 2- or 3-celled hairs and 4-branched round-based glanduliferous hairs intermixed; midrib, secondaries, and principal veinlets visible on both surfaces, prominent and hairy beneath, the veinlets conspicuously reticulate; inflorescence large, terminal, paniculate, ovoid or short-pyramidal, surpassing the leaves, tomentose like the branchlets, the cymes opposite, pedunculate; pedicels much shorter than the flowers; flowers large and conspicuous; calyx broadly turbinate-campanulate, 3.5--6 mm. long, obscurely 2-lipped, externally villous or tomentose, the rim truncate, enlarging and spreading beneath the fruit; corolla about 2.5 cm. long, white with purple and

yellow markings or sometimes entirely purple, externally villous, the tube very broad and apically dilated, 8--10 mm. long, the limb 5-lobed, the lobes ovate, spreading, over 4 mm. long, shorter than the tube, the 2 upper ones smaller and shortly united to form an upper lip, the 3 lower ones larger, forming the lower lip, the middle one purple surrounding 2 small bars of yellow; stamens slender, incurved, inserted near the corolla-base, didynamous, the shorter pair about 12.5 mm. long, the longer pair about 15.5 mm. long, about equalling the upper lip; anther-cells (thecae) two, divergent; style short, slender, about 18.6 mm. long; stigma shortly bifid; ovary globose, 4-locular; fruiting-calyx horizontally patent or flattened, 1.2--1.6 cm. wide, the rim obscurely sinuate-toothed; fruit drupaceous, round or subrotund, 2.5 cm. long and wide or somewhat wider, often deformed or destroyed by insects, blue or mauve to deep-indigo when mature, the exocarp fleshy, the endocarp osseous, the pyrene at least apically 4-celled, each cell 1-seeded; seeds oval, about 7.5 mm. long.

This species is based on an unnumbered Leichhardt collection from Myall Creek, Queensland, Australia, but Mueller (1870) cites also an unnumbered W. Hill collection as *W. Hill, Queensland Woods, London Exhibition (1862) 30* and *Fizalan s.n.* from Queensland, as well as *Beckler s.n., W. Moore N.S. Wales Woods, London Exhibition (1862) 68 & 171* and *Macarthur, Paris Exhibition (1855) 193* from New South Wales. He refers to it as "a fine timber tree".

Collectors have found this plant growing in rainforests, in flower in February and in fruit in April. Clemens describes the corollas as "white with purple".

Francis (1981) asserts that normally the tree flowers in November and December and bears fruit in March and April. He records it from "As far south as Shoalhaven River, N.S.W. (J. H. Maiden), to Eungella Range (west of Mackay), Queensland." He goes on to say that "The timber is one of the most useful of Australian scrub woods. It is durable, easy to work, and does not shrink very much. It is used for almost all indoor purposes such as furniture-making, general fittings, and wood-carving. Owing to the high reputation of the timber in the past and present, it is not plentiful now." He provides photographs of it growing *in situ* in company with *Solanum mauritianum* and *Araucaria cunninghamii*. He notes that "most of the old leaves are shed in November and the new leaves appear early in December or late in November."

As indicated above, the tree is highly prized for its very useful timber, which is employed locally for various purposes, having excellent working quality. In shipbuilding it is used for decking and templates; furthermore it is used in pattern making and turnery, in wood carving, and to manufacture churns, veranda floors, gratings, pulpy blocks, the floats of millwheels, window jambs, picture frames, furniture, wine vats, "and innumerable other purposes".

Vernacular names reported for the species are "beech", "binburra", "coo-in-new", "cullonen", "cullouen:", "gray teak", "grey teak", "Queensland beech", "white-beech", "white beech", and "whitebeech".

Streets (1962) refers to the plant as "A rain-forest species of very wide distribution, from New Zealand to New South Wales and

central Queensland. In New Zealand the rainfall is about 60--100 in a year with a winter maximum, and in Queensland about 40--60 in with a summer maximum. [It is] associated with such species as *Agathis robusta* (Kauri), on damp rich loams in valleys from near sea-level to about 2,500 ft." It has been introduced into Kenya and South Africa in commercial plantings. Troup (1932) reports that in South Africa it is a tree "of slow growth and poor form. A 30year-old plantation at 4,000 ft had a mean height of 30 ft and 12.4 in diameter in a stocking of 34 stems per acre on a deep fine soil with 66-in annual rainfall, many trees were forked."

Maiden (1895) informs us that the species needs careful conservation, perhaps by artificial propagation, since "one sees so few seedlings or saplings.....in its native haunts.....It would be nothing less than a calamity if this valuable tree were to practically die out. In most cases our trees propagate themselves readily, and what is chiefly required is to conserve the young growth..... but in the case of the White Beech I think an exception should be made, and artificial propagation resorted to in suitable localities."

Lord (1964) and Uphof (1968) aver that the species is suitable for the northeastern high forest country of Australia and that in its natural habitat it usually occurs sparsely in the mixed jungles of the coastal lowlands of New South Wales and Queensland." Dadswell & Eckersley (1935) provide detailed notes on the characters of its wood anatomy.

Napp-Zinn (1974), quoting Francis (1928), reports: "Blattstiel mit ein- bis fünfzelligen bräunlichen Haaren, Spreiten-US [=unterseits] mit langen, weichen, zwei- bis dreizelligen Haaren, besonders zahlreich auf den Nerven; viergliedrige Drüsenhaare mit kugelförmiger Basalzelle auf der Spreinte-US."

Mueller (1862) notes: "nuper ad Illawara detegatur, nec non ad flumen Richmond's River. Drupa statu imperfecto visa globosa, exsuccosa,  $\frac{1}{2}$ -- $\frac{2}{3}$ " metiens. De *Ephiel simplicifolia* sive *Vitice macrophylla* videbis observationes eximias Seemanni in Flor. Vit. p. 189."

Kerrer (1938) reports on the chemical characters and formula of the substance, gmelinol, found in this species. Its formula is  $C_{22}H_{26}O_7$ . Birch & Lyons (1938) describe structural studies on the same substance derived from wood shavings and denominated by them as "gmelinolia lignane".

Domin (1928) cites an unnumbered collection made by him in March of 1910 in Australia.

It should be noted here that the Mueller (1862) reference to this species in the bibliography (above) is sometimes cited as "1862--1863", and the author's name is sometimes inaccurately written as "G. L. F. Muell." -- his full name actually was Sir Ferdinand Jacob Heinrich von Müller.

Citations: AUSTRALIA: New South Wales: J. B. Campbell 212 (Ng--16907); Collector undetermined s.n. [Pine Ck., 15.9.1950] (Ng--16906); Maiden s.n. [Port Macquarie, Nov. '9;] (Mi); A. Phillips s.n. [March 1940] (S). Queensland: M. S. Clemens 43570 (Mi), s.n. [Brisbane, 10 April 1945] (Ca--81169, Mi), s.n. [1 February 1946] (Mi), s.n. [March 1947] (F--photo, Ld--photo, N, N--photo, Or--



55583, Si--photo), s.n. [Dalrymple Heights, July-Nov. 1947] (Ca--81168, Mi, N). CULTIVATED: Australia: *Herb. Sydney Bot. Gard. s.n.* (F--photo, Gg--198856, Ld--photo, N--photo, Sg--photo); *Kaulfuss s.n.* [Bot. Gard. Sydney 12.1908] (Mu--4155); *E. Wall 51* [12/1908] (Ew, Ld--photo, N). Hawaiian Islands: *McEldowney s.n.* [Aug. 6, 1948] (Bi, Bi). MOUNTED ILLUSTRATIONS: Francis, *Austral. Rain-for. Trees*, ed. 1, 335, fig. 224. 1929 (Ld) and ed. 4, 369, fig. 231. 1981 (Ld); Maiden, *Agric. Gaz. N. S. Wales* 6: 287. 1895 (Ld).

*Gmelina lepidota* Scheff., *Ann. Jard. Bot. Buitenz.* 1: 41--42. 1876.

Bibliography: F. Muell., *Descrip. Notes Papuan Pl.*, imp. 1, 5: 91 & 113. 1875; Scheff., *Ann. Jard. Bot. Buitenz.* 1: 41--42. 1876; Jacks. in Hook. f. & Jacks., *Ind. Kew.*, imp. 1, 1: 1039. 1893; H. J. Lam, *Verbenac. Malay. Arch.* 216 & 221. 1919; Bakh. in Lam & Bakh., *Bull. Jard. Bot. Buitenz.*, ser. 3, 3: 65 & 71. 1921; Mold., *Known Geogr. Distrib. Verbenac.*, ed. 1, 67 & 93. 1942; Jacks. in Hook. f. & Jacks., *Ind. Kew.*, imp. 2, 1: 1039. 1946; Mold., *Known Geogr. Distrib. Verbenac.*, ed. 2, 149 & 186. 1949; Mold., *Biol. Abstr.* 33: 1215. 1959; Mold., *Résumé* 199, 201, 204, & 456. 1959; Jacks. in Hook. f. & Jacks., *Ind. Kew.*, imp. 3, 1: 1039. 1960; Hocking, *Excerpt. Bot. A.5:* 44. 1962; Whitmore, *Guide For. Brit. Solom. Isls.* 115, 116, 148, & 184. 1966; Mold., *Fifth Summ.* 1: 332, 336, & 339 (1971) and 2: 880. 1971; F. Muell., *Descrip. Notes Papuan Pl.*, imp. 2, 91 & 113. 1979; Mold., *Phytol. Mem.* 2: 322, 327, 329, & 549. 1980; Mold., *Phytologia* 55: 334 & 493. 1984.

A somewhat climbing shrub or tree, to 30 m. tall; trunk to 60 cm. in diameter at breast height; branchlets ferruginous-pubescent; leaves decussate-opposite; petioles about 2.5 cm. long, ferruginous-pubescent; leaf-blades ovate or elliptic to narrow-elliptic, 5.5--11 cm. long, 1.5--6 cm. wide, apically sharply acute or short-acuminate, marginally entire, basally acute or acuminate, glabrous and shiny above, densely brown-lepidote with minute scales beneath; secondaries 4--6 pairs; inflorescence terminal, paniculate, lax, pyramidal, the cymules ferruginous-pubescent; flower-buds yellow; calyx about 5 mm. long, externally lepidote, the rim shortly 5-toothed; corolla large, 1.8 cm. long, externally pubescent, the tube 3 times as long as the smaller lobes, the limb bilabiate, the upper lip 2-lobed, the lower lip 3-lobed with the central lobe longer than the others; stamens 4; filaments pilose; ovary 4-celled, 4-ovulate; fruiting-calyx enlarged, to 8 mm. long; fruit drupaceous, about 1 cm. long, the pyrene 1--4-celled.

Lam (1919) comments: "Its affinity is with *G. Leichhardtii* F. v. Muell. from tropical Australia. The latter species, however, is a tree and differs from the present one in the [leaf] texture, and in the dimensions of calyx and corolla." The present species, however, is also described by collectors as growing to be a large tree. It would appear that the lepidote lower leaf-surface and calyx are its chief distinguishing characters.

*Gmelina lepidota* is based on *Teijsmann 6744* from Tow island, New Guinea, collected in August, 1871, and deposited in the Buitenzorg herbarium. Lam (1919) misspells the island name "Faw". Whitmore

(1966) refers to the species as "a rare big tree" in disturbed lowland forests in the Solomon Islands west to New Guinea, but not on Santa Cruz island. He reports the vernacular name, "maladala". It has been encountered at up to 1000 m. altitude.

Citations: MOLUCCA ISLANDS: Morotai: *Kostermans & Aden 1276* (Bz--72964); *Kostermans, Main, & Aden 1276* (Ng--16920, Ng), 1292 (Bz--72874, N, Ng--16933, Ng). Ternate: *Haan 287* [Boschbouwproefst. bb. 23789] (Bz--21351). NEW GUINEAN ISLANDS: Tow: *Teijsmann 6744* (Bz--21273--type, Ld--photo of type, N--isotype, N--photo of type).

*GMELENA LEPIDOTA* var. *LANCEOLATA* Mold., *Phytologia* 6: 325--326. 1958.

Bibliography: Mold., *Phytologia* 6: 325--326. 1958; Mold., *Biol. Abstr.* 33: 1215. 1959; Mold., *Résumé* 204 & 456. 1959; Hocking, *Excerpt. Bot. A.5:* 44. 1962; Mold., *Fifth Summ.* 1: 339 (1971) and 2: 880. 1971; Mold., *Phytol. Mem.* 2: 329 & 549. 1980; Mold., *Phytologia* 55: 334. 1984.

This variety differs from the typical form of the species in having its leaf-blades quite distinctly lanceolate and more elongate, 12--22.5 cm. long, 3--6 cm. wide, apically acuminate, and basally abruptly acute.

The variety is based on *Mair 1894* from deep volcanic soil in a rainforest, at 500 m. altitude, at Nantambu, Open Bay, New Britain, in the Bismark Archipelago, deposited in the herbarium of the Department of Forests at Lae, New Guinea. The collector describes the plant as a tree, 65 feet tall, the bole 45 feet high, buttressed to 2 feet, with a diameter of 2 feet at breast height, and a leafy crown. The outer bark is described as dark gray-brown, with closely spaced, irregular, longitudinal fissures, scaling off in 6.2--12.5 mm. plates, with some black pustular lenticels unevenly distributed, about 3 mm. thick. The under bark is light creamy-yellow, the inner bark creamy-yellow with light-brown dappling, about 9 mm. thick. The sapwood is indefinite, the wood light straw-color, with a greasy feel. The leaves are decussate-opposite, simple, dark-green above, apically tapering, and with prominent creamy-yellow venation above, dull gray-brown with stellate pubescence and prominent venation beneath. The petioles are 2.5--3 cm. long. The peduncles are tetragonal in cross-section, and the inflorescence is both terminal and axillary in the uppermost leaf-axils, paniculate. The flowers are borne in sessile opposite cymules, subtended by herbaceous bractlets. The corolla is mauve, bilabiate, about 13 mm. long, externally with dark-purple hairs.

Citations: BISMARCK ARCHIPELAGO: New Britain: *Mair 1894* (Ld--isotype, Ng--6593--type).

*GMELENA LIGNUM-VITREUM* Guillaum., *Bull. Mus. Hist. Nat. Paris*, ser. 2, 23: 539--540. 1952.

Synonymy: *Gmelina* [sp.]?, Guillaum., *Bull. Mus. Hist. Nat. Paris*, ser. 2, 22: 118. 1950.

Bibliography: Guillaum., *Bull. Mus. Hist. Nat. Paris*, ser. 2, 22: 118 (1950) and ser. 2, 23: 539--540. 1952; Sarlin, *Cent. Techn. For. Trop. Publ.* 6: [270]--271, 285, 293, & 295, pl. 131. 1954; G. Taylor,

Ind. Kew. Suppl. 12: 63. 1959; Mold., Phytologia 23: 425. 1972; Mold., Phytol. Mem. 2: 331 & 549. 1980; Mold., Phytologia 55: 333. 1984.

Illustrations: Sarlin, Cent. Techn. For. Trop. Publ. 6: [270], pl. 131. 1954.

A small or medium-sized tree; trunk black, elongate, 12--15 m. long, narrow, crooked, smooth, with a diameter of 60--80 cm., diminishing at the rate of 1.6 cm. per m., basally buttressed, eventually fissured, the fissures elongate, narrow, moderate in depth; bark 10--12 mm. thick, even, blackish, the outer portion 3 mm. thick, very firm, dark-colored, the inner portion spongy, friable, 7--8 mm. thick, gray; sapwood white, veined with rose; heartwood salmon-color, very brittle, odorless; branches short, rather crooked, leafy, at first minutely lanuginous, finally glabrous, with black bark; branchlets smooth, dark except for the white leaf-scars and lenticels; leaves decussate-opposite, simple, deciduous in December and January; petioles 2--3 cm. long; leaf-blades membranous, narrowly elliptic or ovate-lanceolate, 10--13 cm. long, 4--7 cm. wide, apically usually acutely attenuate or acute to obtuse, marginally entire, basally cuneately acute or acuminate to rounded, at first minutely lanuginous and glandular on both surfaces, finally glabrous, the venation delicate and distinctly prominent on the lower surface, less so above; inflorescence terminal, spicately paniculate, about 7 cm. long, in the live state malvaceous-silvery, when dried rufous-lanate or pubescent; bracts very narrowly lanceolate or linear; calyx campanulate, externally lanuginous, internally glabrous, the rim more or less irregularly 5-undulate or 5-dentate with small, irregular, apically acute teeth; corolla-tube externally lanuginous or velutinous, internally glabrous, the lobes somewhat unequal, oblique, rounded, in bud 5 mm. long and lanuginous or velutinous on both surfaces; fertile stamens 4; anthers 2-locular, the thecae apically united; staminode 1; style short; fruit fleshy, ovoid, 4 cm. long, 3 cm. wide, plum-color, externally glabrous, the pyrene thick, conic, basally with numerous unequal points.

This species is based on Sarlin 81, 137 in part, & 140 from the forest at Thy, New Caledonia, probably deposited in the Paris herbarium. Guillaumin (1952) comments that it is "Bien différent dès le premier aspect du *G. neocaledonica* S. Moore, notamment par ses feuilles minces, ovals-lanceolées, glabres à l'état adulte".

I know nothing of this apparently endemic New Caledonian species beyond what is said of it in the literature. Guillaumin (1954) says of it "Le bois a une odeur de futaille à l'état vert. Devient jaune clair en séchant, homogène, sans accroissements visibles" and this is followed by more details of the wood anatomy. He concludes: "Bois: Blanc brillant à peine jaunâtre. Bon bois, inutilisable en raison de sa rareté." He records the local vernacular name, "bois de verre", and comments that the deciduous nature of the species is exceptional in the New Caledonian forest flora. He reports that the tree flowers and fruits in December. In his 1950 work he cites Sarlin 81 & 141 from "Forêt de Thy".

Citations: MOUNTED ILLUSTRATIONS: Guillaumin in Sarlin, Cent.

Techn. For. Trop. Publ. 6: pl. 121. 1954 (Ld).

*GMELENA MISOOLENSIS* Mold., *Phytologia* 4: 54. 1952.

Bibliography: Mold., *Phytologia* 4: 54. 1952; Mold., Résumé 203 & 456. 1959; G. Taylor, Ind. Kew. Suppl. 12: 63. 1959; Mold., Fifth Summ. 1: 338 (1971) and 2: 880. 1971; Mold., *Phytol. Mem.* 2: 328 & 549. 1980; Mold., *Phytologia* 55: 335. 1984.

A tree, to 12 m. tall; trunk to 12 cm. in diameter at breast height; branches and branchlets rather stout, glabrate, often white- or gray-flecked; principal internodes 1--7 cm. long; nodes not annulate; leaves decussate-opposite; petioles rather slender, 1.5--2.5 cm. long, nigrescent in drying, glabrous, flattened above; leaf-blades coriaceous, bright-green and very shiny on both surfaces, elliptic, 5.5--12 cm. long, 3--6 cm. wide, apically rounded or obtuse, marginally entire, often somewhat revolute in drying, basally acuminate, very smooth on both surfaces; midrib rather coarse, flat above, very prominent beneath; secondaries very slender, 4--6 per side, arcuate-ascending, anastomosing in many loops several mm. from the margins beneath, flat above, prominulous beneath; veinlet reticulation sparse, flat above, very slightly subprominulous beneath on the larger parts only; inflorescence racemose-paniculate, terminating short axillary twigs, 9--18 cm. long, 2--3 cm. wide, brunnescent or nigrescent throughout in drying; peduncles slender, 2--3.5 cm. long, glabrous; rachis similar to the peduncles, greatly elongated, composed of 5--10 sympodia, strict, glabrous; pedicels very slender, about 2 mm. long, glabrous; flowers not seen; fruiting-calyx campanulate, about 3 mm. long and 5 mm. wide, nigrescent, glabrous on both surfaces, truncate, split to the base into 2 subequal, truncate, quadrate lobes when mature; fruit drupaceous, obovate, green when young, red when ripe, about 12 mm. long and 6 mm. wide (when immature).

The type of this very distinct species was collected by Didit Rudolf Pleyte (no. 1087) at Fakal, on Misool island in the Radja Ampat group of islands, near New Guinea, on September 30, 1948, and is deposited in the Herbarium Bogoriense at Buitenzorg. The species is thus far known to me only from the original collection. The vernacular name, "batan me", has been reported for it.

Citations: NEW GUINEAN ISLANDS: Misool: Pleyte 1087 (Bz--72872--type, Bz--72871--isotype, Ld--photo of type, N--isotype, N--photo of type).

*GMELENA MOLUCCANA* (Blume) Backer ex K. Heyne, *Nutt. Pl. Ned. Ind.* 4: 118. 1917.

Synonymy: *Tittius* Rumpf, *Herb. Amboin.* 3: 38, pl. 20. 1743. *Tittius alba* Rumpf, *Herb. Amboin.* 3: 38. 1743. *Tittius rubra* Rumpf, *Herb. Amboin.* 3: 38, pl. 20. 1743. *Vitex moluccana* Blume, *Bijdr. Fl. Ned. Ind.* 14: 813--814. 1826. *Gmelina macrophylla* Wall., *Numer. List* 49 [=50], no. 1819 hyponym. 1829; Schau. in A. DC., *Prodr.* 11: 680. 1847 [not G., *macrophylla* (R. Br.) Benth., 1870]. *Gmelina glandulosa* H. Hallier, *Meded. Rijks Herb. Leid.* 37: 57. 1918. *Gmelina moluccana* Miq. ex H. Hallier, *Meded. Rijks Herb. Leid.* 37:

57 in syn. 1918. *Gmelina moluccana* Backer apud A. H. Hill, Ind. Kew. Suppl. 7: 104. 1929. *Gmelina salomonensis* Bakh., Journ. Arnold Arb. 16: 72--73. 1935. *Gmelina solomonensis* Bakh. ex Mold., Résumé Suppl. 3: 32 in syn. 1962. *Gmelina solomonensis* Bakh., in herb. *Geunsia moluccana* Lam, in herb.

Bibliography: Rumpf, Herb. Amboin. 3: 38, pl. 20. 1743; Poir. in Lam., Encycl. Méth. Bot. 5: 163. 1804; Blume, Bijdr. Fl. Ned. Ind. 14: 813--814. 1826; Wall., Numer. List 49 [=50], no. 1819. 1829; D. Dietr., Syn. Pl. 3: 611. 1843; Voigt, Hort. Suburb. Calcut. 470. 1845; Schau. in A.D.C., Prodr. 11: 680 & 695. 1847; Buek, Gen. Spec. Syn. Candol. 3: 200 & 502. 1858; Miq., Fl. Ned. Ind. 2: 865 & 867. 1868; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1:1040 (1893) and imp. 1, 2: 1214. 1895; Briq. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, 4 (3a): 173. 1895; H. Hallier, Jahrb. Hamburg. Wiss. Anst. 22 (3): 31--46. 1905; K. Heyne, Nutt. Pl. Ned. Ind., ed. 1, 4: 118. 1917; E. D. Merr., Interpret. Rumph. Herb. Amboin. 452 & 594. 1917; H. Hallier, Meded. Rijks Herb. Leid. 37: 56--67. 1918; H. J. Lam, Verbenac. Malay. Arch. 216, 220, 225--226, & 366. 1919; Bakh. in Lam & Bakh., Bull. Jard. Bot. Buitenz., ser. 3, 3: 65 & 67--68. 1921; Fedde, Justs Bot. Jahresber. 45 (1): 525. 1923; Fedde & Schust., Justs Bot. Jahresber. 45 (1): 148. 1923; H. J. Lam in Lauterb., Engl. Bot. Jahrb. 59: 93. 1924; A. W. Hill, Ind. Kew. Suppl. 6: 92. 1926; K. Heyne, Nutt. Pl. Ned. Ind., ed. 2, 1: 24 (1927), ed. 2, 2: 1321 (1927), and ed. 2, 3: 1646. 1927; Bakh., Journ. Arnold Arb. 10: 71. 1929; A. W. Hill, Ind. Kew. Suppl. 7: 104. 1929; Stapf, Ind. Lond. 6: 479. 1931; Bakh., Journ. Arnold Arb. 16: 72--73. 1935; A. W. Hill, Ind. Kew. Suppl. 9: 125. 1938; Mold., Suppl. List Comm. Vern. Names 22. 1940; Mold., Alph. List Inv. Names 25. 1942; Mold., Phytologia 2: 104. 1945; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 64, 67, 68, & 93. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 1040 (1946) and imp. 2, 2: 1214. 1946; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 144, 148, 150, & 186. 1949; C. T. White, Journ. Arnold Arb. 31: 113. 1950; Mold., Phytologia 4: 178. 1953; Bakh. & Van Steenis, Taxon 5: 81. 1956; Mold., Résumé 190, 197, 199, 201, 204, 296, 297, 354, 386, & 456. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 1040 (1960) and imp. 3, 2: 1214. 1960; Mold., Résumé Suppl. 3: 32. 1962; Whitmore, Guide For. Brit. Solom. Isls. 115, 116, 135, & 184. 1966; Whitmore, Gard. Bull. Singapore 22: [17]--21. 1967; Uphof, Dict. Econ. Pl., ed. 2, 246. 1968; Anon., Biol. Abstr. 50 (12): B.A.S.I.C. S. 84. 1969; Mold., Biol. Abstr. 50: 6338. 1969; Mold., Phytologia 18: 71. 1969; Mold., Résumé Suppl. 18: 12. 1969; Anon., Biol. Abstr. 51 (17): B.A.S.I.C. S.89. 1970; Hocking, Excerpt. Bot. A.15: 422. 1970; Mold., Biol. Abstr. 51: 9630. 1970; Mold., Phytologia 19: 439. 1970; Mold., Excerpt. Bot. A.18: 445. 1971; Mold., Fifth Summ. 1: 325, 330, 332, 336, 339, & 340 (1971) and 2: 523, 524, 643, 722, 880, & 970. 1971; Versteegh, Meded. Landbouwhoges. Wagen. 71-19: 15, 37, & 38. 1971; Foreman, Div. Bot. Dept. For. N. Guin. Bot. Bull. 5: 63, 126, & [127]. 1972; Rouleau, Taxon Ind. 1: 382. 1972; Anon., Gov. For. Exp. Sta. Meguro Tokyo 254: 60, 61, 64, & 66, fig. 2 & 3. 1973; Hartley, Dunstone, Fitzg., Johns, & Lamberton, Lloydia 36: 293. 1973; Farnsworth, Pharmacog. Titles 9 (1): xii. 1974; Mold., Phytologia 28: 448 (1974) and 31:



391. 1975; Mold., Phytol. Mem. 2: 315, 320, 322, 327, 329, 330, 354, 445, & 549. 1980; Mold., Phytologia 55: 330, 334, 335, & 493 (1984) and 56: 35, 38, & 39. 1984.

Illustrations: Rumpf, Herb. Amboin. 3: pl. 20. 1743; Foreman, Div. Bot. Dept. For. N. Guin. Bot. Bull. 5: [127]. 1972; Anon., Gov. For. Exp. Sta. Meguro Tokyo 254: 64 & 66, fig. 243. 1973.

A large, erect, leafy, many-branched, canopy tree, often to 40 m. tall; trunk often buttressed, straight or crooked, the bole cylindrical, to 20 m. long and 1 m. in diameter above the buttresses and 1.5--2 m. in girth, often 62 cm. in diameter at 1.5 m. above the base, 41 cm. at 2 m., and 25 cm. at the first branch, sometimes 10--18 m. to the first branch; buttresses, when present, variable, thick and rounded, sometimes slight or even not prominent but ascending 1.5--3 m. up the trunk and sometimes 50 cm. wide, frequently concave; crown usually dense, sometimes medium-dense or sparse; outer bark dark- or pale-brown to gray-brown, gray, or light yellowish-gray, sometimes brown- or greenish-brown-banded or -blotched, soft, smooth, shallow, 1--3 mm. thick, rather corky, deeply or shallowly and finely longitudinally fissured or fluted (the depressions wide-spaced, about 9 mm. wide and pustular-lenticellate), often exfoliating in small, irregular, thick, pustular flakes; under bark light-straw; inner bark creamy-green or very light- to medium-brown, orange-brown, pale-straw, dirty-white, or pinkish-white, sometimes white-banded, rapidly turning red or orange-red to reddish-brown or brown on exposure, about 1 cm. thick, with an unpleasant odor; outer wood or sapwood white, cream, or straw-color to light- or pale-brown with a pink tinge, light, weak, very soft in cross-cut, with a very unpleasant or sour odor, 3--7 cm. thick or often not clearly defined, the exudate slight and odorless; heartwood very light-brown or brownish. often rotted; slash hard, white; blaze a thin brown line or white with occasional brown flecks, turning to orange in a minute on exposure; branchlets (about 7 mm.) thick, obscurely tetragonal, sparsely lenticellate with scattered, lighter, often green, elliptic lenticels which are raised beneath, the younger parts densely appressed ferruginous- or ochraceous-pubescent or rufous-tomentose, in age glabrescent, grayish, and terete, shiny; leaves decussate-opposite, large, simple, petiolate, held horizontally, usually clustered at the ends of the branches, often attacked by insects, at times shed from the crown; petioles stout, subterete, 1.5--10 cm. long, 2--5 mm. wide, slightly sulcate or canaliculate above, densely ferruginous-puberulent or brown-pubescent with simple hairs in the sulcation and apically when young, later glabrescent; leaf-blades large, coriaceous when mature, oval or ovate to broadly ovate or ovoid, sometimes oblong-elliptic, obovate-subrotund, or obovate, 10--40 cm. long, 7--35 cm. wide, apically very shortly acuminate to blunt or obtuse, marginally entire or lightly and irregularly sinuate, basally subacute or obtuse to rounded or subcordate, dull or glossy dark-green above, paler and light- or gray-green beneath, densely pilose or finely villous when young but finally glabrous (except for the ferruginous-puberulent larger venation) above, softly brown-villous or ferruginous-puberulent to rufous-

tomentose beneath (except for the glabrous larger venation), with 2 rather large concave glands at the base beneath, often rugose or bullate above, sometimes [f. *glandulosa* (H. Hallier) Mold.] also with many large, dark, discoid glands above and similar but smaller ones along the larger venation beneath; secondaries pinnate, 8--18 per side, impressed above, prominently raised beneath; veinlets clathrate-reticulate, prominent beneath; inflorescence racemose, mostly terminal, sometimes also axillary, the terminal ones large, 15--30 cm. long and 10--25 cm. wide, pyramidal-paniculate, pedunculate, very densely appressed ferruginous short-villous, loosely or densely many-flowered, bracteolate, basally foliose, the branches dichotomous and each terminating in a cincinnus or the lower ones paniculate; peduncles 10--15 cm. long, densely brown-tomentose; rachis usually densely dark brown-hairy; flower-buds greenish-brown; cymules rather many-flowered, borne in the axils of deciduous foliose bracts; bractlets small, linear or lanceolate-oblong, 5--10 mm. long, 2--3 mm. wide, apically and basally acute or acuminate, tomentose on both surfaces; flowers rather large or medium in size, subsessile, drooping; calyx cyathiform or cupuliform, about 5 mm. long, 3--7 mm. wide, externally densely ferruginous-villous with long, brown, silky or appressed, ferruginous hairs (except on the rim) or rugous-tomentellous, internally sparsely pubescent or subglabrous, subbilobed, the rim unequally, obtusely and very shortly 5-dentate or subtruncate, with 2--4 black, orbicular or discoid glands of varying size (but mostly small) on the outer surface, resinous-punctate on both surfaces, scarcely enlarged in fruit; corolla showy, white or whitish to purplish-pink, pale-mauve, pale-blue, pale-violet, or purple, often with a yellow throat, sometimes white with a purple lower lip, nigrescent in drying, 2.5--2.6 cm. long, about 2 cm. wide, bilabiate or subbilabiate, externally densely ferruginous-strigulose or with long, brown, silky hair, the tube 1.5--2 cm. long, narrowed for the lower  $\frac{1}{3}$ -- $\frac{1}{4}$  of its length, apically amplified and ventricose, mostly 2--2 $\frac{1}{2}$  times as long as the calyx, externally (except for the lower part) densely pubescent, the lower part glabrescent, the limb unequally 5-lobed, densely farinose-pubescent, copiously resinous-punctate on both surfaces, the upper lip 2-lobed, the lobes broadly ovate, apically obtusely rounded, the lower lip 3-lobed, the 2 lateral lobes similar to the upper ones, 5--10 mm. long and 4--5 mm. wide, the middle lobe larger, 7--10 mm. long and 3.5--5.8 mm. wide, often with a basal deep-mauve patch; stamens 4, didynamous, slightly or scarcely exerted, 1--1.5 cm. long, green in bud; mature filaments pale-lilac, terete, sparsely short-pilose with glanduliferous hairs; anthers subsagittate or unguiform, orange, dorsifixed above the center, 2.5--3 mm. long, introrse, 2-celled, glabrous; style filiform, terete, 2.5--3 cm. long, slightly exerted, sparsely glandular-pilose, apically incurved; stigma unequally bifid, the posterior branch very short, the anterior one subulate; ovary sessile, ovate-oblong, basally externally glabrous, apically densely pubescent, 4-loculate, the cells 1-ovulate; fruiting-calyx persistent, somewhat accrescent, shortly excrescent, almost flat or marginally reflexed, 5--7 mm. wide, 5-angulate; fruit drupaceous, rather large, oblong or subobovate to ovoid, ovoid-globose, or

round, 2.5--3 cm. long, 1.2--2 cm. wide (when dry), at first green or light-green with purple dots to greenish-red or red, maturing very dark-blue, purple, purplish-black, or black, shiny, apically depressed, at first externally farinose, finally glabrous, the nut-like endocarp obovate, thickly woody, apically flattened and centrally umbonate, marginally 5-torous, by abortion 1-celled and 1-seeded.

Collectors have encountered this plant in primary forests and light woods, coastal and low-ridge rainforests, in well-drained secondary forests on flat plains, in forests on sandy loam soil, in orange-brown clay of general lowland rainforests, and even in grasslands, at altitudes of sealevel to 1200 m., in flower from March to June, as well as in August and November, and in fruit in March, from May to July, and from September to December. Brass & Versteegh report it "rare on slopes in primary forests". Main & Aden found it "scattered along rivers"; Whitmore refers to it as a "common big tree" in the Solomon Islands, where Brass also reports it as "a common tall tree, attaining a large size".

The corollas are described as "purple" on Clemens 3219, "pale-violet, yellow in the throat" on Stone & Streitmann 10336, "pale-blue" by Womersley & Van Royen, "blue with pink tip, a yellow patch inside of lower lip" on Main 1854, "pale-mauve" on Walker 169, "purplish-pink" on Wiakabu & al. 73347, "purplish-white with a yellow stripe on inner side of lip" on Kuswarta & Soepadmo 103, "light-violet" on Kostu B.W.1804, "violet-purple, the longest lobe deep-mauve with a yellow patch" on Sayers NGF.21642, "white" on Brower 2522 and Buwalda 606, "white, the lip purple and throat yellow" on Foreman & Katik LAE.59277, "brown" on Main & Aden 941, and "light-brown on Schram BW.1814.

*Gmelina moluccana* is native to the Molucca Islands, New Guinea, New Britain, and the Solomon Islands. Its wood is used for light construction, boat decking, planking, furniture, turnery, joinery, and moldings. Evans refers to the species as "a valuable timber tree" in New Guinea, used there by the natives in canoe-making. Uphof (1968) refers to the wood as "very suitable for native vessels" and gives the tree's overall distribution as Malaya and Indonesia, especially Celebes. Hartley & al. (1973) refer to it as a "Medium to large tree in disturbed lowland and foothills rain forests", citing nos. 10467, 10915, & 11024. Foreman (1972) cites *Kajewski* 2228 -- his publication is date "1971" on the titlepage, but did not actually get published until 1972.

Schram refers to *Gmelina moluccana* as "rather common" in West Irian, while Idjan & Moohtar found it to be "rare" there. Bakhuizen (1935) cites Brass 2860 from San Cristoval island.

Various authors (e.g. Adanson, 1763) place *Tittius* Rumpf as a synonym of the genus *Gmelina* as a whole, while others (e.g. Merrill, 1917) place it only in the synonymy of *G. moluccana*. In his 1917 work Merrill says of *G. moluccana*: "This very characteristic species is known only from Amboina and Banka, the specimens cited above [C. B. Robinson 296] agreeing perfectly with Rumphius' figure and description and with a series of specimens collected in Amboina by Botter, Heyne, Teysmann 5031 and Binnendyck and with Teysmann 5158

from Banda. Poiret, in Lamarck Encycl, 5 (1804) 163, suggested that t. 20 [of Rumpf's work] might be *Clerodendron infortunatum* Linn., but erroneously cites the description of *Tittius litorea*. It has nothing in common with that species. The plate is *Vitex moluccana*, but the description cited [i.e. the description of *T. litorea*] is a *Clerodendron* [now, however, regarded as, instead, applying to *Guettarda speciosa* L. in the Rubiaceae]. Blume cites the Rumphius plant in the original description of his *Vitex moluccana*, in which he has been followed by later authors. It seems very probable that the two forms indicated by Rumphius as *Tittius alba* and *Tittius rubra* are merely slight variants of the same species."

Bakhuizen (1921) cites *Teijsmann 1859 & 5031* from Amboina, *Teijsmann 5158* from Banda, and *Heyne 194* from Ceram. Fedde & Schuster (1923) erroneously cite *Teijsmann 5158* from Amboina. Lam (1924) cites *Schlechter 16441* from Northeastern New Guinea, giving the overall distribution of the species as Amboina, the Moluccas, and New Guinea. Voigt (1845) records it as cultivated in the vicinity of Calcutta.

Foreman (1972) states that the tree sometimes has a similar appearance to *Anthocephalus*, while the fruit is superficially like that of *Elaeocarpus sphaericus* "but it is somewhat rougher in appearance". Several authors refer to the fruit as "baccate" or "berry-like", but it is actually and very plainly a drupe. Some collectors refer to its possessing "spur-roots to 2½ feet long."

Hallier (1917) has pointed out that "Bei logischer Anwendung des Prioritätsgrundsatzes auf vollständige Artnamen, nicht auf unselbständige spezifische Attribute, gebührt der *Gm. macrophylla* Wall. ed, Schauer 1847 vor *Gm. macrophylla* Benth. 1870 der Vorzug. Letztere muss hiernach den Namen *Gm. Dalrympleana* (F. v. Muell. 1864-4) m. erhalten." For his *G. glandulosa* he cites as synonym *Tittius alba* Rumpf and "*Vitex moluccana* (haub. Bl.!) Miq. l.c. (1856) p. 865 quoad specim. Reinw.! tantum." He bases the species on Reinwardt 1362 from Ay island and DeVriese s.n. from Neira, both of these islands being in the Banda group of the Molucca Islands, the former collected in June, 1821, and the latter in May, 1859.

*Gmelina salomonensis* is based on Brass 3309, collected at Tira-toña, at 600 m. altitude, on Ysabel island in the Solomons, on December 8, 1932. Bakhuizen (1935) avers that "This plant is intermediate between *G. moluccana* (Bl.) Backer and *G. macrophylla* (R. Br.) Benth. and may be a hybrid between these species. From *G. moluccana* it differs in the tomentose under side of the leaves and the villous calyx; from *G. macrophylla* in the terete branches, the elevated nerves and veins on the upper side of the leaves, somewhat in the form of [the] panicles, but especially in the small and regular 5-toothed calyx."

Blume's original (1826) description of *Vitex moluccana* is: "V. foliis simplicibus subrotundo-ovatis aut ovalibus acutiusculis subintegerrimis coriaceis infra puberulis basi que glandulosis, panicula terminali divaricatis."

Heyne (1917) has described the wood of this species and also discussed the "white" and "red" forms described by Rumpf, giving their characteristics as "de witte is voor vaartuigen meer geschikt dan de

roode, daar het hout wel water opzuigt, doch spoedig meer droog wordt. Dat van den anderen vorm is rooder; ook dat zwelt op in het water, maar scheurt bij het drogen. De roode wordt daarom het minst aangeplant." Wood specimens to illustrate these features are deposited in the Buitenzorg museum.

Common and vernacular names recorded for this species are "arakoko", "arokoko", "caju titti", "daun titti", "gow", "hai", "kajoe titi", "kajoe titi mera", "kajoe titipeiti", "kajuĥ tittie", "kaju titi", "kaju titie", "kaju tittie", "koko", "omormi", "ossogee", "tietie", "tietieje", "titi", "titie", "titipoeti", "titti", "toehoe", and "toeroe".

Schauer (1847) cites only Wallich 1819 in the DeCandolle Herbarium at Geneva, an admittedly "incomplete" specimen from material collected in the Calcutta Botanical Garden, originally from Amboina, the type collection of *G. macrophylla* Wall.

White (1950) cites as *G. salomonensis* from the Solomon Islands Walker B.S.I.P. 257 and Walker & White B.S.I.P. 59 & 169 and comments that number 59 is a good match for the type gathering but no. 169 & 257 differ in the adult leaves being glabrous or the young and half-grown leaves having a slight pubescence on the midrib and main lateral nerves on the lower surface. "The species is very close to *G. moluccana* (Bl.) Backer. Bakhuizen.....suggests it may be a hybrid between that species and *G. macrophylla* (R. Br.) Benth. The glabrous character of the New Georgia and San Cristobal specimens (nos. 169 & 257) suggest an approach to this latter species." I regard these collections as representing *G. moluccana* f. *glabrescens* (Mold.) Mold.

Whitmore (1967), in his detailed discussion of *G. moluccana*, says that "There is a common *Gmelina* found throughout the Solomons. It is a big tree of disturbed lowland-forest and is well known locally as it is the best canoe timber in the archipelago. We have made many collections of this species. There are two fairly distinct varieties which have different ranges. Thus: (1) Leaves densely velvety below, rather thick in texture; inflorescence axes, stems and petioles densely fulvous tomentose all over; fruit sometimes cylindrical; central and eastern Solomons. Collections seen (all BSIP series unless indicated): Santa Ysabel 2487, 4072, 2301 Brass 3309. Guadalcanal 59\*, 649. Malaita 3501. San Cristobal 4255; Brass 2860\*. (2) Leaves glabrous below except for a few hairs on veins, rather thin in texture; inflorescence axes, stems and petioles partly glabrous partly fulvous tomentose but thinly so; fruit always conical; western Solomons (except 257). Collections seen (all BSIP series): San Cristobal 257\*. Shortlands Fauro 3949, 5708. New Georgia Islands: Baga 1870, 5573 Gizo 5603 Kolombangara 819, 851. Rendova 1854 New Georgia 169\*, 3709. The starred numbers are at BRIS and L; the others (i.e. the recent part of the BSIP series) at K, L, LAE, US, and SING.

"The hairiness and texture of the leaves apparently does not depend on their maturity, all leaves on every collection are similar to one another. Nevertheless I prefer not to give these differences specific status as in their essential parts these taxa are the same. The hairy leaved eastern form is a good match for *G. moluccana* (Bl.) Backer, abundantly represented at Leiden and Lae from New Britain,



all over New Guinea and the Moluccas.....All the sheets seen have coriaceous leaves, most of them velvety hairy but a few glabrous or glabrescent below (e.g. NGF 1854, 4580, 5870, 8213). There is none of the other form is [=in] Lae or Leiden. As with the Solomons' material there is no suggestion that texture or degree of hairiness changes much on ageing.

"*G. salomonensis* Bakh. was described on the basis of a single collection, Brass 3309, from Santa Ysabel, Tiratoná. Bakhuizen stated that it is intermediate and possibly a hybrid between *G. moluccana* and *G. macrophylla* (R. Br.) Benth., which is properly called *G. dalrympleana* (F. Muell.) H. J. Lam.....I have examined an isotype at Leiden which fits the hairy-leaved typical *G. moluccana* of the eastern Solomons, although the leaves are rather large, slightly thinner and less hairy than is usual.

"White.....annotating Walker's Solomons' collections also noted how close *G. salomonensis* is to *G. moluccana*. On the other hand *G. dalrympleana* in Moldenke's sense is a very distinct entity as I show below. It has not been found yet east of mainland New Guinea and none of the Solomons' collections come near to it, including, in my opinion, the type of *G. salomonensis*. In my opinion *G. salomonensis* must be considered synonymous with *G. moluccana*, which occurs in the archipelago in its typical form in the eastern islands and in a glabrous form in the western islands. The glabrous form may be Moldenke's *G. salomonensis* forma *glabrescens*.....from Bougainville."

Bakhuizen (1921) distinguishes *G. moluccana* from other species of the genus known to him as follows:

1. Inflorescence axillary, 1--few-flowered; calyx 1.5--2.5 cm. long, with large deltoid segments, densely villous within.
- 1a. Inflorescence terminal, paniculate, many-flowered; calyx 0.5--1 cm. long, shortly toothed to subtruncate, glabrous or with some hairs within.
2. Ovary densely hairy, especially toward the top; flowers with a shade of purple in the center, sometimes bright yellow or bright blue.
3. Leaves more or less densely pubescent beneath; calyx 0.5--1 cm. long, with some long hairs within.....*G. moluccana*.
- 3a. Leaves glabrous beneath or scarcely pubescent on the veins only; calyx 3--5 mm. long, glabrous within.*G. macrophylla*.  
[=*G. dalrympleana*].
- 2a. Ovary glabrous or nearly so; flowers yellow.
4. Trees; inflorescence terminal, erect; leaves large.
5. Calyx glabrous; filaments distinctly hairy...*G. palawensis*.
- 5a. Calyx densely pubescent; filaments glabrous or with some glanduliferous hairs.
6. Leaves oblong or subobovate, basally truncate or subcuneate, apically short-acuminate, glabrous or somewhat pubescent on the veins beneath.....*G. arborea*.
- 6a. Leaves broadly ovate, basally cordate, apically abruptly acuminate, densely hairy beneath.....*G. asiatica*.
- 4a. Climbing shrubs; inflorescence subpendulous; leaves small.
7. Corolla large, 4-lobed, apically ventricose, 4--9 times as long as the calyx.....*G. asiatica*.

7a. Corolla small, 5-lobed, less than 4 times as long as the

calyx.....*G. lepidota*.

It should, of course, be noted that *G. arborea* and *G. asiatica* are not regarded in this key in the same sense as in the present work.

Material of *G. moluccana* has been misidentified and distributed in some herbaria as *Guettarda speciosa* L., *Faradaya splendida* F. Muell., *Volkameria obovata* Roxb., and *Clerodendrum obovatum* Walp.

Citations: GREATER SUNDA ISLANDS: Java: Reinwardt 379 (S). LESSER SUNDA ISLANDS: Timor: Therik 23 [Boschproefst. bb.7217] (Bz--21349, Bz--21350). MOLUCCA ISLANDS: Amboina: Binnendyk s.n. (Bz--21281, Bz--21282); Botter s.n. (Bz--21285, Bz--21286, Bz--21287, Bz--21288, Ut--63385); Heyne s.n. (Bz--72824, Bz--72825); C. B. Robinson 296 (Bz--72823, N, W--654614); Teijsmann 1859 (Bz--21280, Bz--21283), 5031 (Bz--21284). Banda: DeBell 32 [Boschproefst. bb.13437] (Bz--21289, Bz--21290, N); Teijsmann 5158 (Bz--21291, Ut--44155). Buru: Oersipuny 193 [Boschproefst. bb.24455] (Bz--21294, N). Ceram: Buwalda 606 [Boschproefst. bb.25951] (Bz--21292, Bz--21293); Kuswatz & Soepadmo 103 (N). Halmahera: Beguin 1746 (Bz--21298, Bz--21299, Bz--21300, N, Ut--70965). Morotai: Kostermans & Aden 941 (Bz--72963); Main & Aden 941 (Ng--16855); Tangkilisan 257 [Boschproefst. bb.33927] (Bz--72584). Tanimbar: Buwalda 212 [Boschproefst. bb.24431] (Bz--21352). Ternate: Beguin 1408 (Bz--21296, Bz--21297). Tobelo: Haan 384 [Boschproefst. bb.24572] (Bz--21295). NEW GUINEA: Papua: Clemens & Clemens 3219 (A, B); A. J. Hart 5036 (Ng--16868, Ng); Jackson & McDonald 4580 (Ng--16939); Matatula 11 [Boschproefst. bb.21807] (Bz--21353); Wiakabu & al. LAE.73347 (W--2936453); Womersley & Van Royen 5870 (Ng--16918, Ng). Territory of New Guinea: Evans 74 (Ng--16946); E. Gray 5217 (Ng--16947, Ng); Sayers NGF.21642 (Mi, N); Vickery NGF.1428 (Ng--6597, Ng--16895). West Irian: Brass & Versteegh 13580 (A); Brower BW.2522 (Ng--16909); Idjan & Moohtar 321 (Ng--16866); Koster BW.1104 (Ng--20201); Kostermans 61 [Boschproefst. bb.33304] (Bz--73015), 442 [Boschproefst. bb.33600] (Bz--72809, Bz--72810); Schram BW.1814 (Ng--20219), BW.2730 (Ng--20214). BISMARK ARCHIPELAGO: Manus: Foreman & Katik LAE.59277 (Mu); Stone & Streimann 10336 [LAE.53836] (Mu, W--2917579). New Britain: Floyd 6637 (Bi, Ng--16915, W--2603275); Mair 1854 (Ng--6593); N.G.F.141 (Ng--6592). SOLOMON ISLANDS: New Georgia: Ma'enu'u s.n. [Herb. Brit. Sol. Isls. Prot. 6463] (W--2578862). San Cristoval: Brass 2860 (Bi, Bz--21303, Bz--21304). Ysabel: Beer's Collector s.n. [Herb. Brit. Sol. Isls. Prot. 7078] (W--2578234); Brass 3309 (Bi, Bz--21334, Bz--21335, Ld--photo, N, N--photo). LOCALITY OF COLLECTION UNDETERMINED: Herb. Hort. Bot. Bogor 21301 (Bz), 21302 (Bz); Roxburgh 2632 (Br). MOUNTED CLIPPINGS & ILLUSTRATIONS: Foreman, Div. Bot. Dept. For. N. Guin. Bot. Bull. 5: [127]. 1972 (Ld); Merr., Interpret. Rumph. Herb. Amboin. 452. 1917 (W).

GMELENA MOLUCCANA var. ELLIPTICA (Mold.) Mold., Phytologia 19: 439. 1970; Mold., Phytologia 55: 334. 1984.

Synonymy: *Gmelina salomonensis* var. *elliptica* Mold., Phytologia 18: 71. 1969.

[to be continued]